(19)日本国特許庁（ＪＰ）　(12)**公開特許公報（Ａ）**　(11)特許出願公開番号

特開平8－17708

(43)公開日　平成８年(1996)１月19日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｈ０１Ｌ　21/027				
Ｇ０３Ｆ　1/08		Ａ		
Ｈ０１Ｌ　21/3065				
			Ｈ０１Ｌ　21/ 30　５７２	
			21/ 302　Ｈ	

審査請求　未請求　請求項の数６　ＯＬ　（全　６　頁）

(21)出願番号　特願平6－146502

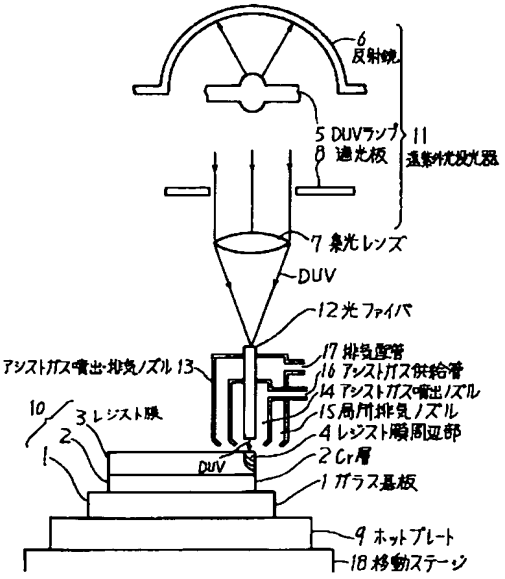
(22)出願日　平成６年(1994)６月28日

(71)出願人　000005223
富士通株式会社
神奈川県川崎市中原区上小田中1015番地
(72)発明者　宮園　祐成
神奈川県川崎市中原区上小田中1015番地
富士通株式会社内
(74)代理人　弁理士　井桁　貞一

(54)【発明の名称】　樹脂膜剥離方法及び装置とマスク及び半導体装置の製造方法

(57)【要約】
【目的】　樹脂膜剥離方法及びそれに用いる装置と、前記樹脂膜剥離方法を用いたマスク及び半導体装置の製造方法に関し、選択的な樹脂膜剥離における剥離時間の短縮及び剥離品質の向上を図る。
【構成】　被処理基板１上に被着された樹脂膜３に集光した遠紫外光(DUV)を連続的に移動照射して該樹脂膜３の該遠紫外光に照射された周辺領域４を選択的に除去する樹脂膜剥離方法において、該遠紫外光(DUV)の照射と同時に、該遠紫外光(DUV)に照射されている周辺領域４に異なる種類のアシストガスを噴射ノズル14を介し交互に吹きつけ該領域４の雰囲気を交互に変化させる樹脂膜剥離方法と、上記機能を備えた樹脂膜剥離装置、及び前記樹脂膜剥離方法を用いて基板周辺部の樹脂膜を選択的に除去するマスク及び半導体装置の製造方法。

本発明に係る樹脂膜剥離装置の一実施例の要部模式図(その1)



1

【特許請求の範囲】

【請求項１】　被処理基板(1) 上に被着された樹脂膜(3) に集光した遠紫外光(DUV) を連続的に移動照射して該樹脂膜(3) の該遠紫外光(DUV) に照射された領域(4) を選択的に除去する樹脂膜剥離方法において、該遠紫外光(DUV) の照射と同時に、該遠紫外光(DUV) に照射されている領域(4) にアシストガスを間欠的に吹きつけ該領域の雰囲気を間欠的に変化せしめることを特徴とする樹脂膜剥離方法。

【請求項２】　被処理基板(1) 上に被着された樹脂膜(3) に集光した遠紫外光(DUV) を連続的に移動照射して該樹脂膜(3) の該遠紫外光(DUV) に照射された領域(4) を選択的に除去する樹脂膜剥離方法において、該遠紫外光(DUV) の照射と同時に、該遠紫外光(DUV) に照射されている領域(4) に異なる種類のアシストガスを交互に吹きつけ該領域の雰囲気を交互に変化せしめることを特徴とする樹脂膜剥離方法。

【請求項３】　前記樹脂膜がレジスト膜からなることを特徴とする請求項１または２記載の樹脂膜剥離方法。

【請求項４】　移動ステージ(18)と、該移動ステージ(18)上に載置され、表面に樹脂膜(3) を有する被処理基板(1) を搭載加熱するホットプレート(9) と、集光系を備え該樹脂膜(3) の一部領域(4) 上に遠紫外光(DUV) を照射する遠紫外光照射機構(11)と、該遠紫外光(DUV) が照射されている該一部領域(4) に、１種類のアシストガスを間欠的に、若しくは２種類以上のアシストガスを交互に吹きつけるアシストガス吹きつけ機構(13)とを有してなることを特徴とする樹脂膜剥離装置。

【請求項５】　遮光膜が形成されたガラス基板上にレジスト膜を塗布した後、該レジスト膜にパターン露光を行う前に、該ガラス基板周辺部上の該レジスト膜を前記請求項１、２または３記載の樹脂膜剥離方法により選択的に除去する工程を有することを特徴とするマスクの製造方法。

【請求項６】　半導体基板上にレジスト膜を塗布した後、該レジスト膜にパターン露光を行う前に、該半導体基板の周辺部上の該レジスト膜を前記請求項１、２または３記載の樹脂膜剥離方法により選択的に除去する工程を有することを特徴とする半導体装置の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は樹脂膜剥離方法及びそれに用いる装置と、前記樹脂膜剥離方法を用いたマスク及び半導体装置の製造方法に関する。

【０００２】近年、デバイスパターンの微細化及び高精度化に伴い、デバイスの性能に悪影響を及ぼし問題となる欠陥サイズはより一層細かくなってきている。そのため、半導体装置やその製造に用いられるマスクの製造工程では、上記欠陥の原因になる微細な異物（パーティクル）の発生を防止することが極めて重要になる。

2

【０００３】上記欠陥につながる異物の発生原因の一つに、マスクパターンやデバイスパターンのパターニングマスクに用いるレジストの砕片（レジストダスト）がある。このレジストダストは、ガラスや半導体の基板上にスピンコート法によりレジストを塗布した際、基板の周辺部にレジストが厚く被着し、基板搬送時等における基板のクランプでこの厚いレジストがフレーク状に欠け落ちることによるもので、このレジストダストの発生を防止することが前記マスク及び半導体装置を製造する際のレジストプロセスにおいて重要な課題になっている。

【０００４】

【従来の技術】図５はレチクル（マスク）製造工程における乾板60のレジスト塗布後の状態を示す模式図で、図５(a) は該乾板の平面図、図５(b) は同側面断面図を示す。

【０００５】レチクル製造工程における乾板60は図５(b) に示すように、ガラス基板51の表面に遮光膜としてのクロム層52が形成されており、その上に例えば厚さ５００nmのレジスト膜53が通常スピンコート法により設けられている。この形成方法に由来してレジスト膜53の周辺から２～５mm以内の周辺部54は厚く盛り上がり、最高が1.5μm程度にまで達する。

【０００６】この周辺部54の厚く盛り上がったレジスト53P は、搬送あるいは露光等のために乾板をクランプする場合等において他の物体と接触することによってフレーク状のダストとなって剥離し易く、このレジストダストは、乾板の状態ではレジスト表面に付着しているが、露光の後、現像してレジスト膜53をパターニングした段階においてレジストの除去された部分に付着し、該レジストパターンをマスクにして行われるクロム層52のパターンエッチングの際にパターン欠陥を発生させるという問題を生ずる。

【０００７】そこで従来、レジストが遠紫外光の照射により分解して除去されることに着目し、ガラス基板上にスピンコートによりレジスト膜を形成した後、レジスト膜が被着された基板面に触れずに、ガラス基板の周辺部のレジスト膜が厚く被着した領域に選択的に遠紫外光を照射し、その部分のレジスト膜を除去する下記の装置を用いたレジスト膜の選択的な剥離方法が開発され、これによって露光、搬送等に際してクランプされる周辺部のレジスト膜を予め選択的に除去して上記問題を回避する方法が提供された。（特開平０５－３３３５６４）

図６は上記レジスト膜を選択的に除去する機構を備え、且つレジスト膜のスピンコート機構を兼ね備えた従来のレジスト剥離装置の模式図である。

【０００８】図６において、１はガラス基板、２はクロム(Cr)層、３はレジスト膜、４はレジスト膜の周辺部、５は遠紫外光(DUV) ランプ、６は反射鏡、７は集光レンズ、８は遮光板、９はホットプレート、10は乾板、11は遠紫外光投光器、23はスピンコータ、24は支持台、25は

レジスト注下用のノズル、26は搬送ロボットを示す。

【０００９】この装置を用いるレジスト剥離方法においては、先ず乾板10をホットプレート９上に固定し、これをスピンコータ23の支持台24上に置く。そして、乾板10のCr膜２上にレジスト膜３を、ノズル25からレジストを供給しスピンコートして形成する。次いで、レジスト膜３周辺部４の除去に際しては、搬送ロボット26によりホットプレート９と共に乾板10を遠紫外光投光位置へ搬送する。そして、ホットプレート９によりレジストのプリベーク温度である例えば 200℃に保持しながらレジスト周辺部４に５mm程度の幅で例えば 200mW/cm² の照度を有する遠紫外光を100mm/min 程度の走査速度で順次照射し、乾板10の周辺部のレジスト膜３を５mm程度の幅で選択的に除去する。

【００１０】このようにして形成されたレジスト膜３を表面に有する乾板10は、露光等に際してクランプされる乾板10周辺部のレジスト膜４が予め除去されるので、レジストダストの発生が防止されるという効果を生ずる。

【００１１】

【発明が解決しようとする課題】しかしながら上記従来のレジスト剥離方法は、レジストの剥離速度が遅く、特に乾板の周辺部にレジスト膜が厚く被着されている場合、上記走査速度では該周辺部のレジストが十分に除去されず、レジストダストの発生が完全に防止できないという問題があり、更に走査速度を遅くしなければならなかった。

【００１２】そこで本発明は遠紫外光を用いるレジスト剥離方法におけるレジストの剥離速度を向上させることによって遠紫外光の走査速度を低下させずにレジスト膜周辺部の剥離除去を完全にし、工程手番の増大を伴わずに前記露光工程等において発生するレジストダストによる障害を完全に防止することを目的とする。

【００１３】

【課題を解決するための手段】上記課題の解決は、被処理基板上に被着された樹脂膜に集光した遠紫外光を連続的に移動照射して該樹脂膜の該遠紫外光に照射された領域を選択的に除去する樹脂膜剥離方法において、該遠紫外光の照射と同時に、該遠紫外光に照射されている領域にアシストガスを間欠的に吹きつけ該領域の雰囲気を間欠的に変化せしめる本発明による樹脂膜剥離方法、若しくは、被処理基板上に被着された樹脂膜に集光した遠紫外光を連続的に移動照射して該樹脂膜の該遠紫外光に照射された領域を選択的に除去する樹脂膜剥離方法において、該遠紫外光の照射と同時に、該遠紫外光に照射されている領域に異なる種類のアシストガスを交互に吹きつけ該領域の雰囲気を交互に変化せしめる本発明による樹脂膜剥離方法、若しくは、移動ステージと、該移動ステージ上に載置され樹脂膜を表面に有する被処理基板を搭載加熱するホットプレートと、集光系を備え該樹脂膜の一部領域上に遠紫外光を照射する遠紫外光照射機構と、

該遠紫外光が照射されている該一部領域に１種類のアシストガスを間欠的に若しくは２種類以上のアシストガスを交互に吹きつけるアシストガス吹きつけ機構とを有してなる本発明による樹脂膜剥離装置、若しくは、遮光膜が形成されたガラス基板上にレジスト膜を塗布した後、該レジスト膜にパターン露光を行う前に、該ガラス基板周辺部上の該レジスト膜を前記請求項１、２または３記載の樹脂膜剥離方法により選択的に除去する工程を有する本発明によるマスクの製造方法、若しくは、半導体基板上にレジスト膜を塗布した後、該レジスト膜にパターン露光を行う前に、該半導体基板の周辺部上の該レジスト膜を前記請求項１、２または３記載の樹脂膜剥離方法により選択的に除去する工程を有する本発明による半導体装置の製造方法によって達成される。

【００１４】

【作用】波長が 200～300nm 程度の遠紫外光を樹脂の例えばレジストに照射すると、レジストは炭酸ガスと水とに分解して除去されることが知られている。

【００１５】しかしその際、遠紫外光の照射を例えば酸素(O_2)等の一定種類のアシストガスの雰囲気内で行うと、時間の経過と共にレジスト表面が不活性になって上記反応の速度が低下しレジストの剥離速度が遅くなる。

【００１６】そこで本発明の樹脂膜剥離方法においては、例えば大気中で遠紫外光を照射してレジスト剥離を行う際、遠紫外光の照射されている領域に大気と種類の異なる１種類のアシストガスを間欠的に吹きつけるか、あるいは種類の異なる２種類以上のアシストガスを交互に吹きつけることにより該遠紫外光照射中の該領域のアシストガスの雰囲気を交互に変化させてやる。

【００１７】このようにすることにより、１種類のアシストガス中で連続して照射される遠紫外光の照射時間はごく短時間に分割されるので、形成される不活性物質膜の膜厚は極めて薄くなり、次の異なる種類のアシストガス中における遠紫外光照射のステップで容易に剥離除去される。

【００１８】従って、遠紫外光照射中、レジスト膜の表面は不活性物質に覆われず常に活性なレジスト表出面となるため、前記アシストガス中での最大のレジストの剥離レートが維持され、従来に比べてレジストの剥離速度が大幅に向上する。

【００１９】従って、上記本発明に係る樹脂膜剥離方法を適用して乾板あるいは半導体基板上にスピンコートされたレジスト膜の周辺部を選択的に除去することにより、該乾板あるいは半導体基板がクランプされるそれらの周辺部のレジスト膜は従来より短時間で完全に除去できるので、製造手番の短縮が図れると同時に、露光等に際しての乾板あるいは半導体基板のクランプによるレジストダストの発生は回避され、該レジストダストに起因して生ずるマスクあるいは半導体装置のパターン欠陥は防止される。

5

【００２０】

【実施例】以下本発明を、図示実施例により具体的に説明する。図１は本発明に係る樹脂膜剥離装置の一実施例の要部模式図（その１）、図２は本発明に係る樹脂膜剥離装置の一実施例の要部模式図（その２）、図３は本発明の樹脂膜剥離方法の一実施例のタイムチャート、図４は本発明の樹脂剥離方法の一実施例の工程断面図である。全図を通じ同一対象物は同一符合で示す。

【００２１】本発明に係る樹脂膜剥離装置の剥離処理部を示す図１の要部模式図（その１）において、１はガラス基板、２はCr層、３はレジスト膜、４は該レジスト膜の周辺部、５は遠紫外光(DUV) ランプ、６は反射鏡、７は集光レンズ、８は遮光板、９はホットプレート、10は乾板、11はDUV ランプ，遠紫外光投光器，反射鏡，遮光板，集光レンズ等により構成された遠紫外光透光器、12は光ファイバ、13はアシストガス噴出・排気ノズル、14はアシストガス噴出ノズル、15は局所排気ノズル、16はアシストガス供給管、17は排気配管、18は移動ステージ、DUV は遠紫外光を示す。

【００２２】また、本発明に係る樹脂膜剥離装置のアシストガス供給制御部を示す図２の要部模式図（その２）において、16はアシストガス供給管、19A は第１の電磁弁、19B は第２の電磁弁、20A は第１のアシストガス供給管、20B は第２のアシストガス供給管、$21A_1$、$21A_2$、$21A_3$は流量計、$22A_1$、$22B_1$はO_2が供給される流量調整バルブ、$22A_2$、$22B_2$はO_3が供給される流量調整バルブ、$22A_3$、$22B_3$はN_2が供給される流量調整バルブ、23はアシストガス制御部を示している。

【００２３】例えば 125mm角のマスク製造において、２種類のアシストガスO_2とO_3を用いる本発明の方法により乾板上にスピンコートされたレジスト膜の周辺部を選択的に除去する際には、前記図１及び図２に示した樹脂膜剥離装置を用い、該装置に付属する従来装置（図６参照）同様の図示されないスピンコータにより、ホットプレート９上搭載された状態で 125mm角のガラス基板１の表面のCr層２上に厚さ 500nm程度のレジスト膜３をスピンコートした後、このレジスト膜３を有する乾板10を、ホットプレート９ごと移動ステージ18上に載置し、ホットプレート９により 200℃程度に加熱し、その状態においてステージ18を乾板10の辺に沿う方向に移動しながら遠紫外光投光器11の集光レンズ７から放出される波長 200～300nmの遠紫外光(DUV) を光ファイバ９を介しレジスト膜４の周辺部の５mm程度の幅の領域に照射し、且つ前記ステージ18の移動に従ってレジスト膜３の周辺部を５mm程度の幅で乾板10の辺に沿って順次連続的に照射して行く。そしてそれに並行して、レジスト膜３の前記遠紫外光に照射されている部分を含む領域にアシストガス噴出・排気ノズル13を介して異なる２種類のアシストガスのO_2とO_3を交互に吹きつけ、該遠紫外光に照射されている領域の雰囲気をO_2とO_3に交互に切り換えてやる。このアシストガスのO_2とO_3との交互吹きつけのガスの種類、ガス流量、タイミング等の制御は、図２に示すアシストガス供給制御部によってなされる。即ち、例えば第１のアシストガス供給管20A 内にそれに接続された流量調整バルブ$22A_1$からO_2を所定の流量に制御して供給し、第２のアシストガス供給管20B 内にそれに接続された流量調整バルブ$22B_2$からO_3を例えばO_2と等しい所定の流量に制御して供給し、アシストガス制御部23により第１の電磁弁19A と第２の電磁弁19B を所定のタイミングで交互に開閉し、アシストガス供給管16にO_2とO_3を所定のタイミングで交互に供給することによってなされる。

【００２４】図３はこの実施例における、遠紫外光(DUV) 照射のタイミングと異なるアシストガスのO_2、O_3の噴出のタイミングの関係を示したタイムチャートで、 DUVの照射時間ａ中に交互に噴射されるO_2とO_3の噴射時間ｂ及びｃはそれぞれ３～５secに制御されている。

【００２５】この実施例において、 DUVランプにはメタルハライドランプを用い、波長 250nm付近の遠紫外光照度は200mW/cm² に調整した。また遠紫外光照射の移動（走査）速度即ちステージ18の移動速度は 100mm/minに調整した。また、アシストガスのO_2、O_3の流量はそれぞれ２l/min に制御し、それらの切り換えのタイミングは３～５sec とした。なお、アシストガス噴出・排気ノズル13によりアシストガスが吹きつけられる領域は約30mmφである。

【００２６】図４は上記マスク製造工程の実施例の模式工程断面図である。図４(a) はレジスト膜３のスピンコートを終わった乾板10を示した図で、レジスト膜３のスピンコート厚さは 500nmを目標にしてなされているが、レジスト膜３の周辺部４では厚さ１～1.5 μm程度の厚さに形成される。

【００２７】図４(b) は上記実施例の方法によりレジスト膜周辺部４のレジストの盛り上がり部3Pが除去されたレジスト剥離の途中の状態を示す。そしてさらに DUV照射とアシストガスO_2、O_3の交互吹きつけが継続され、図４(c) に示すように、該乾板10の周辺部10P の幅５mmの領域のレジスト膜３が完全に除去され該領域のCr膜２が完全に表出された時点でレジスト膜３の選択的な剥離除去が完了する。

【００２８】この実施例によれば、上記遠紫外光の走査速度 100/minで図４(c) に示すように、１～1.5 μm程度に厚く付着していた乾板10周辺部のレジスト膜４は完全に除去された。このことは、レジストの剥離速度が従来の２～３倍に向上したことを示している。

【００２９】上記実施例においては、本発明に係る樹脂膜剥離方法をマスク製造に適用したが、上記乾板を半導体基板に置き換えることにより、半導体装置の製造にも適用され、且つ同様の効果をうることができることは勿論である。

【００３０】また　上記実施例においては、異なる２種

7

類のアシストガスを交互に吹きつけて遠紫外光照射領域の雰囲気を交互に変化させたが、大気中において上記実施例の装置を用い大気と異なる成分組成の１種類のアシストガス例えばO_3を上記実施例と類似の間隔で間欠的に吹きつけても、遠紫外光照射領域の雰囲気が大気とO_3とに交互に変わるので、ほぼ前記実施例同様の効果が得られる。

【００３１】更にまた、異なる２種類のアシストガスを用いる場合、図２に示したアシストガス制御部で、単一成分のアシストガスを混合して形成した異なる組成の混合ガスを、異なる２種類のアシストガスとして用いてもよい。

【００３２】更にまた、３種類以上の異なる種類のアシストガスを用いても勿論さしつかえない。

【００３３】

【発明の効果】以上説明のように本発明に係る樹脂膜剥離方法によれば、乾板あるいは半導体基板上にスピンコートされたレジスト膜の周辺部を選択的に、従来より短時間で且つ完全に除去することができるので、マスクあるいは半導体基板の製造手番の短縮が図れると同時に、レジストダストに起因してマスクあるいは半導体装置に生ずるパターン欠陥も防止される。従って本発明は、微細且つ高精度なパターンを有するマスク及び半導体装置の、品質及び歩留りの向上等に寄与するところが大きい。

【図面の簡単な説明】

【図１】　本発明に係る樹脂膜剥離装置の要部模式図（その１）

8

＊【図２】　本発明に係る樹脂膜剥離装置の要部模式図（その２）

【図３】　本発明の樹脂膜剥離方法の一実施例のタイムチャート

【図４】　本発明の樹脂膜剥離方法の一実施例の工程断面図

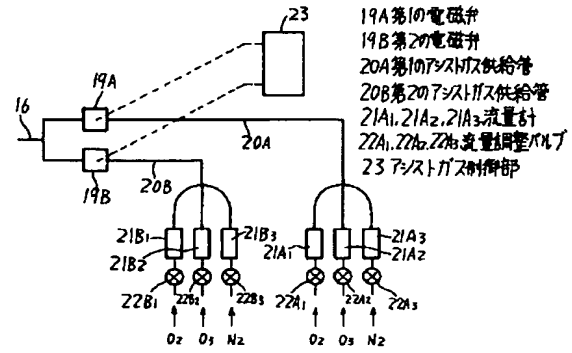
【図５】　乾板のレジスト塗布後の状態の模式図

【図６】　従来のレジスト剥離装置の模式図

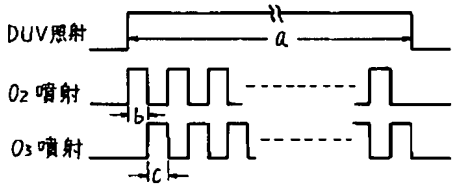
【符号の説明】

1　ガラス基板
2　Cr層
3　レジスト膜
4　該レジスト膜の周辺部
5　遠紫外光(DUV) ランプ
6　反射鏡
7　集光レンズ
8　遮光板
9　ホットプレート
10　乾板
11　遠紫外光投光器
12　光ファイバ
13　アシストガス噴出・排気ノズル
14　アシストガス噴出ノズル
15　局所排気ノズル
16　アシストガス供給管
17　排気配管
18　移動ステージ
DUV 遠紫外光

【図２】

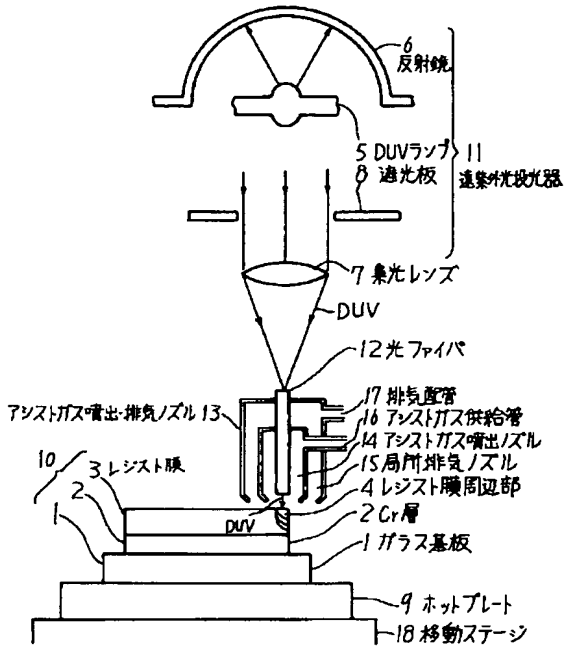


【図３】



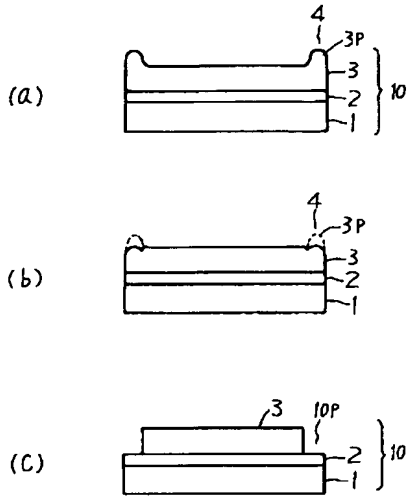
【図１】

本発明に係る樹脂膜剥離装置の一実施例の要部模式図(その1)



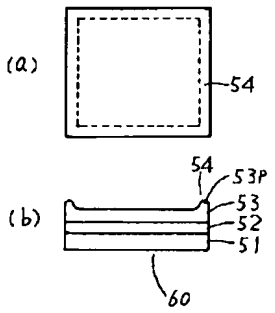
【図４】

本発明の樹脂膜剥離方法の一実施例の工程断面図



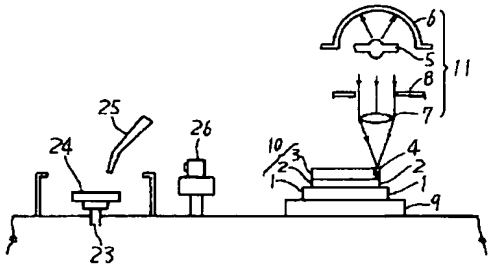
【図５】

乾板のレジスト塗布後の状態の模式図



【図６】

従来のレジスト剥離装置の模式図



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-017708
(43)Date of publication of application : 19.01.1996

(51)Int.Cl. H01L 21/027
G03F 1/08
H01L 21/3065

(21)Application number : 06-146502
(22)Date of filing : 28.06.1994

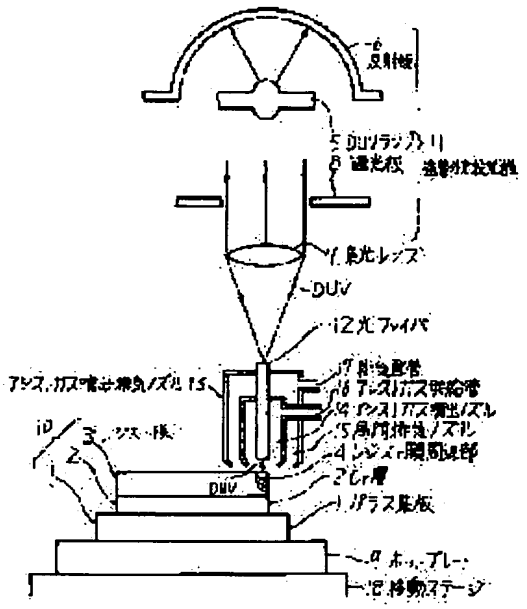
(71)Applicant : FUJITSU LTD
(72)Inventor : MIYAZONO SUKENARI

(54) METHOD AND APPARATUS FOR EXFOLIATION OF RESIN FILM AS WELL AS MASK AND MANUFACTURE OF SEMICONDUCTOR DEVICE

(57)Abstract:

PURPOSE: To enhance the exfoliation speed of a resist and to completely exfoliate and remove a resist-film peripheral part by a method wherein an assistance gas whose kind is different from that of the air is blown intermittently on a region which is irradiated with far-ultraviolet rays.

CONSTITUTION: A dry plate 10 which has a resist film 3 is placed on a movement stage 18 together with a hot plate 9, and it is heated to about 200°C by the hot plate 9. In this state, while the stage 18 is being moved to a direction along the side of the dry plate 10, a region in a resist-film peripheral part 4 is irradiated, via an optical fiber 12, with far-ultraviolet rays, at a wavelength of 200 to 300nm, which are radiated from a condensing lens 7 for a far- ultraviolet ray projector 11, and, while the stage 18 is being moved, the peripheral part of the resist film 3 is irradiated sequentially and continuously along the side of the dry plate 10. Then, in parallel with this, two different kinds of assistance gases are blown alternately, via an assistance-gas blowoff and evacuation nozzle 13, on a region including the part which is irradiated with the far-ultraviolet rays on the resist film 3.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Processed substrate (1) Resin film put upwards (3) Far-ultraviolet light which condensed (DUV) A migration exposure is carried out continuously and it is this resin film (3). This far-ultraviolet light (DUV) Irradiated field (4) It sets to the resin film exfoliation approach removed selectively, and is this far-ultraviolet light (DUV). To an exposure and coincidence This far-ultraviolet light (DUV) Field currently irradiated (4) The resin film exfoliation approach characterized by spraying assist gas intermittently and making the ambient atmosphere of this field change intermittently.
[Claim 2] Processed substrate (1) Resin film put upwards (3) Far-ultraviolet light which condensed (DUV) A migration exposure is carried out continuously and it is this resin film (3). This far-ultraviolet light (DUV) Irradiated field (4) It sets to the resin film exfoliation approach removed selectively, and is this far-ultraviolet light (DUV). To an exposure and coincidence This far-ultraviolet light (DUV) Field currently irradiated (4) The resin film exfoliation approach characterized by spraying the assist gas of a different class by turns, and making the ambient atmosphere of this field change by turns.
[Claim 3] The resin film exfoliation approach according to claim 1 or 2 characterized by said resin film consisting of resist film.
[Claim 4] it lays on a migration stage (18) and this migration stage (18) -- having -- a front face -- resin film (3) Processed substrate (1) which it has Hot plate (9) which carries out loading heating It has a condensing system and is this resin film (3). It is a field (4) a part. It is far-ultraviolet light (DUV) upwards. The far-ultraviolet light exposure device to irradiate (11), this far-ultraviolet light (DUV) it irradiates -- this -- a part -- field (4) Resin film exfoliation equipment characterized by coming to have the assist gas spraying device (13) in which two or more kinds of assist gas is sprayed by turns intermittently [assist gas / one kind of].
[Claim 5] The manufacture approach of the mask characterized by having the process which removes selectively this resist film on this glass substrate periphery by said resin film exfoliation approach according to claim 1, 2, or 3 before performing pattern exposure on this resist film, after applying the resist film on the glass substrate with which the light-shielding film was formed.
[Claim 6] The manufacture approach of the semiconductor device characterized by having the process which removes selectively this resist film on the periphery of this semi-conductor substrate by said resin film exfoliation approach according to claim 1, 2, or 3 before performing pattern exposure on this resist film, after applying the resist film on a semi-conductor substrate.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the manufacture approach of of the equipment used for the resin film exfoliation approach and it, and the mask and semiconductor device using said resin film exfoliation approach.
[0002] In recent years, the defective size which has an adverse effect on the engine performance of a device, and poses a problem is becoming still finer with detailed-izing and high-degree-of-accuracy-izing of a device pattern. Therefore, in the production process of the mask used for a semiconductor device or its manufacture, it becomes very important to prevent generating of the detailed foreign matter (particle) leading to the above-mentioned defect.
[0003] The debris (resist dust) of the resist used for the patterning mask of a mask pattern or a device pattern is in one of the causes of generating of the foreign matter which leads to the above-mentioned defect. When this resist dust applies a resist with a spin coat method on the substrate of glass or a semi-conductor, a resist puts it on the periphery of a substrate thickly, it is because this thick resist is missing in the shape of a flake and falls by the clamp of the substrate in the time of substrate conveyance etc., and has been an important technical problem in the resist process at the time of preventing generating of this resist dust manufacturing said mask and semiconductor device.
[0004]
[Description of the Prior Art] Drawing 5 is the mimetic diagram showing the condition after resist spreading of the dry plate 60 in a reticle (mask) production process, and is drawing 5 R> 5 (a). The top view of this dry plate, and drawing 5 (b) This side-face sectional view is shown.
[0005] The dry plate 60 in a reticle production process is drawing 5 (b). The chromium layer 52 as a light-shielding film is formed in the front face of a glass substrate 51 so that it may be shown, and it is thickness on it. The 500nm resist film 53 is usually formed by the spin coat method. It originates in this formation approach, the less than 2-5mm periphery 54 rises thickly from the circumference of the resist film 53, and the highest amounts to about 1.5 micrometers.
[0006] resist 53P to which this periphery 54 rose thickly Although it became flake-like dust, it was easy to exfoliate and this resist dust has adhered to the resist front face in the state of a dry plate by contacting other bodies when clamping a dry plate for conveyance or exposure It adheres to the part from which the resist was removed in the phase which developed negatives and carried out patterning of the resist film 53 after exposure, and the problem of generating a pattern defect in the case of pattern etching of the chromium layer 52 performed by using this resist pattern as a mask is produced.
[0007] Then, it notes that a resist decomposes by the exposure of far-ultraviolet light, and is removed conventionally. The ** which does not touch the substrate side where the resist film was put after forming the resist film with a spin coat on a glass substrate, The resist film of the periphery of a glass substrate irradiates far-ultraviolet light selectively to the field put thickly. The alternative exfoliation approach of the resist film using the following equipment from which the resist film of the part is removed was developed, and the method of removing beforehand selectively the resist film of the periphery clamped by this on the occasion of exposure, conveyance, etc., and avoiding the above-mentioned problem was offered. (JP,05-333564,A)
Drawing 6 is the mimetic diagram of the conventional resist exfoliation equipment which was equipped with the device in which the above-mentioned resist film is removed selectively, and has the spin coat device of the resist film.
[0008] drawing 6 -- setting -- 1 -- a glass substrate and 2 -- a chromium (Cr) layer and 3 -- the resist film and

4 -- the periphery of the resist film, and 5 -- far-ultraviolet light (DUV) a lamp and 6 -- a reflecting mirror and 7 -- a condenser lens and 8 -- in a gobo and 9, a far-ultraviolet light projector and 23 show a spin coater and the nozzle for [24] the bottoms of resist notes in susceptor and 25, and, as for a hot plate and 10, 26 shows a carrier robot, as for a dry plate and 11.
[0009] In the resist exfoliation approach using this equipment, a dry plate 10 is first fixed on a hot plate 9, and this is placed on the susceptor 24 of a spin coater 23. And on the Cr film 2 of a dry plate 10, from a nozzle 25, a resist is supplied, and the spin coat of the resist film 3 is carried out, and it is formed. Subsequently, on the occasion of clearance of resist film 3 periphery 4, a dry plate 10 is conveyed to a far-ultraviolet light floodlighting location with a hot plate 9 with a carrier robot 26. and it is the prebaking temperature of a resist by the hot plate 9 -- for example -- while holding at 200 degrees C -- the resist periphery 4 -- width of face of about 5mm -- for example, -- the far-ultraviolet light which has the illuminance of 200 mW/cm2 -- 100 mm/min A sequential exposure is carried out with the scan speed of extent, and the resist film 3 of the periphery of a dry plate 10 is selectively removed by width of face of about 5mm.
[0010] Thus, since the resist film 4 of dry-plate 10 periphery clamped on the occasion of exposure etc. is removed beforehand, the dry plate 10 which has the formed resist film 3 on a front face produces the effectiveness that generating of resist dust is prevented.
[0011]
[Problem(s) to be Solved by the Invention] However, the above-mentioned conventional resist exfoliation approach had the slow exfoliation rate of a resist, when the resist film was thickly put especially on the periphery of a dry plate, in the above-mentioned scan speed, the resist of this periphery is not fully removed, but has the problem that generating of resist dust cannot prevent thoroughly, and had to make the scan speed late further.
[0012] Then, this invention makes exfoliation clearance of a resist film periphery perfect, without reducing the scan speed of far-ultraviolet light by raising the exfoliation rate of the resist in the resist exfoliation approach of using far-ultraviolet light, and it aims at preventing thoroughly the failure by the resist dust generated in said exposure process etc., without being accompanied by buildup of a process move.
[0013]
[Means for Solving the Problem] In the resin film exfoliation approach of removing selectively the field to which solution of the above-mentioned technical problem carried out the migration exposure of the far-ultraviolet light which condensed on the resin film put on the processed substrate continuously and which was irradiated by this far-ultraviolet light of this resin film the exposure of this far-ultraviolet light, simultaneously the resin film exfoliation approach by this invention to which spray assist gas on the field currently irradiated by this far-ultraviolet light intermittently, and the ambient atmosphere of this field is made to change intermittently -- or In the resin film exfoliation approach of removing selectively the field to which the migration exposure of the far-ultraviolet light which condensed on the resin film put on the processed substrate was carried out continuously and which was irradiated by this far-ultraviolet light of this resin film The resin film exfoliation approach by this invention which the assist gas of a class which is different to the field currently irradiated by this far-ultraviolet light is sprayed [this invention] on an exposure and coincidence of this far-ultraviolet light by turns, and makes the ambient atmosphere of this field change to them by turns, or a migration stage, The hot plate which carries out loading heating of the processed substrate which is laid on this migration stage and has the resin film on a front face, It has a condensing system. This resin film a part The far-ultraviolet light exposure device which irradiates far-ultraviolet light on a field, Resin film exfoliation equipment this far-ultraviolet light is irradiated -- this -- a part -- it is based on this invention which comes to have the assist gas spraying device in which two or more kinds of assist gas is sprayed on a field by turns intermittently [assist gas / one kind of] -- Or after applying the resist film on the glass substrate with which the light-shielding film was formed, The manufacture approach of the mask by this invention which has the process which removes selectively this resist film on this glass substrate periphery by said resin film exfoliation approach according to claim 1, 2, or 3 before performing pattern exposure on this resist film, Or after applying the resist film on a semi-conductor substrate, before performing pattern exposure on this resist film It is attained by the manufacture approach of the semiconductor device by this invention which has the process which removes selectively this resist film on the periphery of this semi-conductor substrate by said resin film exfoliation approach according to claim 1, 2, or 3.
[0014]
[Function] Wavelength 200-300nm If the far-ultraviolet light which is extent is irradiated at the resist of

resin, decomposing a resist into carbon dioxide gas and water, and being removed is known.
[0015] However, if far-ultraviolet light is irradiated within the ambient atmosphere of the assist gas of fixed classes, such as oxygen (O2), in that case, with the passage of time, a resist front face becomes inactive, the rate of the above-mentioned reaction will fall and the exfoliation rate of a resist will become slow.
[0016] Then, in the resin film exfoliation approach of this invention, in case far-ultraviolet light is irradiated, for example in atmospheric air and resist exfoliation is performed, the ambient atmosphere of the assist gas of this field under this far-ultraviolet light exposure is changed by turns by spraying intermittently one kind of assist gas with which atmospheric air differs from a class on the field to which far-ultraviolet light is irradiated, or spraying by turns two or more kinds of a certain assist gas with which it is and sowings differ.
[0017] Since the irradiation time of the far-ultraviolet light continuously irradiated in one kind of assist gas by doing in this way is divided very much for a short time, the thickness of the inactive substance film formed becomes very thin, and exfoliation clearance is easily carried out at the step of the far-ultraviolet light exposure in the assist gas of the class from which a degree differs.
[0018] Therefore, during a far-ultraviolet light exposure, since the front face of the resist film is not covered with an inactive substance but turns into an activity always resist table labor attendant, the exfoliation rate of the greatest resist in the inside of said assist gas is maintained, and its exfoliation rate of a resist improves substantially compared with the former.
[0019] Therefore, by removing selectively the periphery of the resist film by which the spin coat was carried out on the dry plate or the semi-conductor substrate with the application of the resin film exfoliation approach concerning above-mentioned this invention Since the resist film of those peripheries with which this dry plate or a semi-conductor substrate is clamped is thoroughly removable from the former in a short time While compaction of a manufacture move can be aimed at, generating of the resist dust by the clamp of the dry plate for exposure etc. or a semi-conductor substrate is avoided, and the pattern defect of the mask which originates in this resist dust and is produced, or a semiconductor device is prevented.
[0020]
[Example] Below, a graphic display example explains this invention concretely. The timing diagram of one example of the resin film exfoliation approach of this invention and drawing 4 of the important section mimetic diagram (the 1) of one example of the resin film exfoliation equipment which drawing 1 requires for this invention, the important section mimetic diagram (the 2) of one example of the resin film exfoliation equipment which drawing 2 requires for this invention, and drawing 3 are the process sectional views of one example of the resin exfoliation approach of this invention. The same agreement shows the same object through a complete diagram.
[0021] In the important section mimetic diagram (the 1) of drawing 1 showing the exfoliation processing section of the resin film exfoliation equipment concerning this invention In 1, a glass substrate and 2 the resist film and 4 for Cr layer and 3 The periphery of this resist film, 5 is far-ultraviolet light (DUV). A lamp and 6 a condenser lens and 8 for a reflecting mirror and 7 Gobo, For a hot plate and 10, a dry plate and 11 are [9] DUV. Lamp, Far-ultraviolet light projector, Reflecting mirror, Gobo, the far-ultraviolet light light transmission machine constituted with the condenser lens etc., 12 -- an optical fiber and 13 -- an assist gas blowout and an exhaust nozzle, and 14 -- an assist gas blowout nozzle and 15 -- a local ventilation nozzle and 16 -- an assist gas supply pipe and 17 -- an exhaust pipe arrangement and 18 -- a migration stage and DUV Far-ultraviolet light is shown.
[0022] Moreover, it sets to the important section mimetic diagram (the 2) of drawing 2 showing the assist gas supply control section of the resin film exfoliation equipment concerning this invention. 16 is an assist gas supply pipe and 19A. The 1st solenoid valve and 19B The 2nd solenoid valve, 20A The 1st assist gas supply pipe and 20B The 2nd assist gas supply pipe, The positive crankcase ventilation valve with which, as for the positive crankcase ventilation valve with which, as for 21A1, 21A2, the positive crankcase ventilation valve with which, as for 21 A3, a flow meter, 22A1, and 22B1O2 are supplied, 22A2, and 22 B-2, O3 is supplied, 22 A3, and 22B3, N2 is supplied, and 23 show the assist gas control section.
[0023] For example In case the periphery of the resist film by which the spin coat was carried out on the dry plate by the approach of this invention using two kinds of assist gas O2 and O3 is selectively removed in mask manufacture of 125mm angle Using the resin film exfoliation equipment shown in said drawing 1 and drawing 2 by the spin coater same with the former as equipment (refer to drawing 6) attached to this equipment which is not illustrated In the condition of having been carried on the hot plate 9 It is thickness on the Cr layer 2 of the front face of the glass substrate 1 of 125mm angle. After carrying out the spin coat of the about 500nm resist film 3, The dry plate 10 which has this resist film 3 is laid on the migration stage 18 the whole hot plate 9. Hot plate 9 It heats at about 200 degrees C. Wavelength emitted from the

condenser lens 7 of the far-ultraviolet light projector 11 while moving in the direction along the side of a dry plate 10 in the condition on a stage 18 200-300nm far-ultraviolet light (DUV) A field with a width of face [of the periphery of the resist film 4] of about 5mm is irradiated through an optical fiber 9. And according to migration of said stage 18, the sequential per-continuum exposure of the periphery of the resist film 3 is carried out along the side of a dry plate 10 by width of face of about 5mm, and it goes. And in parallel to it, O2 and O3 of two kinds of different assist gas through an assist gas blowout and an exhaust nozzle 13 are sprayed on the field containing the part currently irradiated by said far-ultraviolet light of the resist film 3 by turns, and the ambient atmosphere of the field currently irradiated by this far-ultraviolet light is switched to O2 and O3 by turns. It is made by the assist gas supply control section of O2 and O3 of this assist gas which shows control of the class of gas of mutual spraying, a quantity of gas flow, timing, etc. to drawing 2 . Namely, 1st assist gas supply pipe 20A Inside, from the positive crankcase ventilation valve 22A1 connected to it, control O2 to a predetermined flow rate, and it is supplied. 2nd assist gas supply pipe 20B Inside, from positive crankcase ventilation valve 22 B-2 connected to it, control O3 to a predetermined flow rate equal to O2, and it is supplied. It is the 1st solenoid-valve 19A by the assist gas control section 23. The 2nd solenoid-valve 19B It opens and closes by turns to predetermined timing, and is made by supplying O2 and O3 to the assist gas supply pipe 16 by turns to predetermined timing.

[0024] Drawing 3 is the far-ultraviolet light (DUV) in this example. The injection time b and c of O2 and O3 injected by turns in the irradiation time a of DUV is controlled by the timing diagram which showed the relation of the timing of a blowout of different assist gas from the timing of an exposure of O2 and O3 by 3-5sec, respectively.

[0025] it sets in this example -- a DUV lamp -- a metal halide lamp -- using -- wavelength whenever [near 250nm / far-ultraviolet Mitsuteru] -- 200mW/cm2 It adjusted. (Moreover, the migration (scan) rate of a far-ultraviolet light exposure, i.e., passing speed of a stage 18, It adjusted to 100 mm/min.) Moreover, the flow rate of O2 and O3 of assist gas is 2l. / min, respectively. Controlling, the timing of those switches is 3-5sec. It carried out. In addition, the field on which assist gas is sprayed by an assist gas blowout and the exhaust nozzle 13 is about 30mmphi.

[0026] Drawing 4 is the ** type process sectional view of the example of the above-mentioned mask production process. Drawing 4 (a) It is drawing having shown the dry plate 10 which finished the spin coat of the resist film 3, and is the spin coat thickness of the resist film 3. Although made for the purpose of 500nm, at the periphery 4 of the resist film 3, it is thickness 1-1.5. It is formed in the thickness about mum.

[0027] Drawing 4 (b) The condition in the middle of being the resist exfoliation from which climax section 3P of the resist of the resist film periphery 4 was removed by the approach of the above-mentioned example is shown. To and a pan Mutual spraying of a DUV exposure and assist gas O2 and O3 is continued, and it is drawing 4 R> 4 (c). It is periphery 10P of this dry plate 10 so that it may be shown. When the resist film 3 of a field with a width of face of 5mm is removed thoroughly and the Cr film 2 of this field is expressed thoroughly, alternative exfoliation clearance of the resist film 3 is completed.

[0028] According to this example, it is the scan speed of the above-mentioned far-ultraviolet light. It is drawing 4 (c) at 100/min. It is 1-1.5 so that it may be shown. The resist film 4 of dry-plate 10 periphery which had adhered to mum grade thickly was removed thoroughly. This shows that the exfoliation rate of a resist improved by 2 to 3 times over the past.

[0029] In the above-mentioned example, although the resin film exfoliation approach concerning this invention was applied to mask manufacture, by transposing the above-mentioned dry plate to a semiconductor substrate, it is applied also to manufacture of a semiconductor device, and, of course, can deal in the same effectiveness.

[0030] Again Although two kinds of different assist gas was sprayed by turns in the above-mentioned example and the ambient atmosphere of a far-ultraviolet light exposure field was changed by turns Since the ambient atmosphere of a far-ultraviolet light exposure field changes to atmospheric air and O3 by turns even if it sprays intermittently one kind of assist gas of a different component presentation from atmospheric air using the equipment of the above-mentioned example, O3 [for example,], at intervals of the above-mentioned example and resemblance into atmospheric air, the almost same effectiveness as said example is acquired.

[0031] Furthermore, when using two kinds of different assist gas again, the mixed gas of a different presentation which mixed and formed the assist gas of a single component by the assist gas control section shown in drawing 2 may be used as two kinds of different assist gas.

[0032] Furthermore, even if it uses the assist gas of three or more kinds of different classes, of course, it does not interfere again.

[0033]
[Effect of the Invention] Since the periphery of the resist film by which the spin coat was carried out on the dry plate or the semi-conductor substrate is thoroughly [are a short time and] removable from the former selectively according to the resin film exfoliation approach which starts this invention like explanation above, while compaction of the manufacture move of a mask or a semi-conductor substrate can be aimed at, the pattern defect which originates in resist dust and is produced in a mask or a semiconductor device is also prevented. Therefore, the place of this invention which contributes to improvement in the quality and the yield of the mask which has a detailed and highly precise pattern, and a semiconductor device etc. is large.

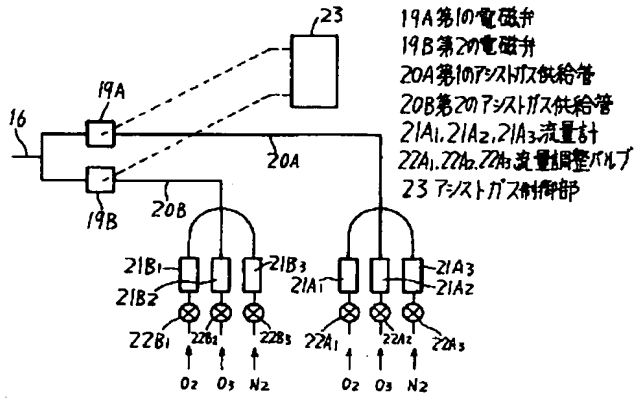
[Translation done.]

* NOTICES *

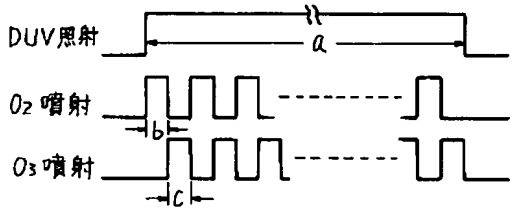
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 2]
本発明に係る樹脂膜剥離装置の一実施例の要部概式図(その2)

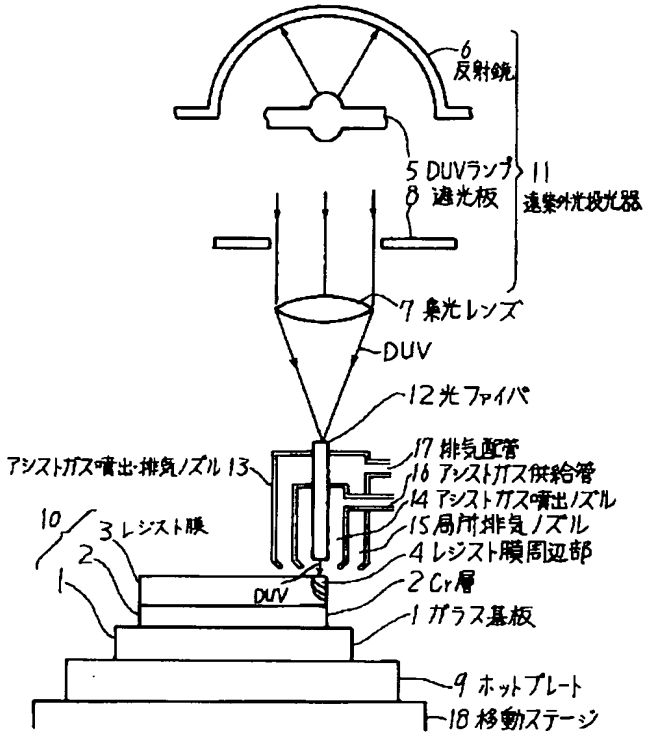


[Drawing 3]
本発明の樹脂膜剥離方法の一実施例のタイムチャート



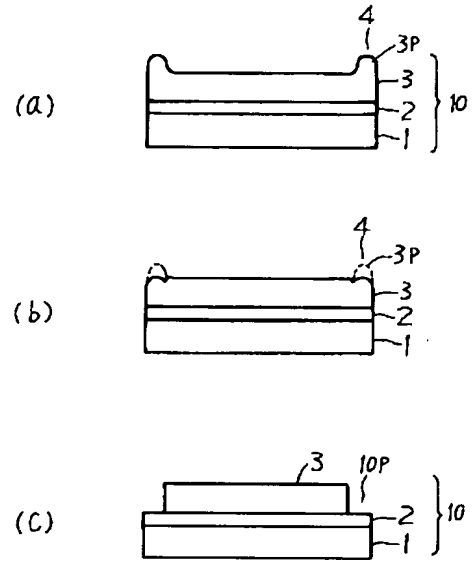
[Drawing 1]

本発明に係る樹脂膜剥離装置の一実施例の要部模式図(その1)



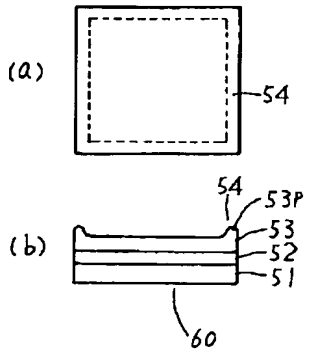
[Drawing 4]

本発明の樹脂膜剥離方法の一実施例の工程断面図



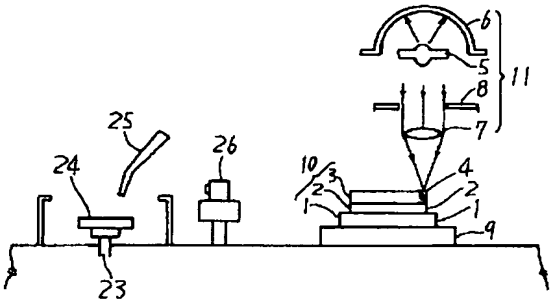
[Drawing 5]

乾板のレジスト塗布後の状態の模式図



[Drawing 6]

従来のレジスト剥離装置の模式図



[Translation done.]